

Heat Switches for Cryogenic Application with Polycrystalline Magnetostrictive and Superconducting Flux Tube Actuation

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A mechanical heat switch is described with rapid closure times, and good open-switch isolation. Heat leak between the switch and warmer surfaces in a dewar is negligible. Switch closure times are in the milli-second range. These heat switches are designed to replace slower gas-gap switches in many applications. Applications include isolating calorimeters, and the thermal shorting of heat shields to shorten cool down times on cryogenic apparatus. A novel feature of this switch is that the prime mover is polycrystalline Tb/Dy which functions best cryogenically. This is the first practical application of this actuator material. The strain energy in these polycrystals returns the actuator to the resting state, eliminating return springs. The prime mover produces maximum stroke at cryogenic temperatures, unlike piezoelectric and electrostrictive devices that are attenuated at these temperatures. The actuating flux is provided by a superconducting solenoid, or High Temperature Superconducting Solenoid (HTSC). The HTSC's for this project are new, compact HTSC solenoids provided by American Superconductor Corporation. The normal operation of the switch is "energize-to-activate" however, bi-stable operation of the switch is possible using a superconducting flux tube as an adjustable source of flux.

*magnetostriction
high temperature superconductor*

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